

# Two More Moon Tracking Computer Programs



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The first moon tracking computer program included here was rewritten from WA1JXN/WA3GPL and K5JL versions presented in earlier issues of the EME notes. Warren Butler, W2WD, wrote the program for TRS-80 level II BASIC(16K). Cassette copies of the program are available from Warren for the cost of the cassette and postage (approximately \$1.00).

The second program was written in FORTRAN IV by Geoffrey Grayer, G3NAQ. Again the WA1JXN/WA3GPL program served as the starting point for this effort.

[illegible]

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51Ø INPUT F(N), V(N), Y(N)
52Ø IF F(N)=Ø THEN 64Ø
53Ø NEXT N
54Ø GOTO 5ØØ
55Ø INPUT"DO YOU WANT HARDCOPY (YES/NO)";WW$
56Ø PRINT
57Ø PRINT"WHAT ARE THE GMT MONTH, DAY, YEAR, TIME BEGINNING, TIME ENDING?"
58Ø PRINT"USE THE FORMAT MM,DD,YYYY,TTTT,TTTT
REMINDER --- USE 4 DIGITS FOR YEAR!"
59Ø FOR N=1TO31
60Ø INPUT F(N), V(N), Y(N), Q(N), S(N)
61Ø IF F(N)=Ø THEN 64Ø
62Ø NEXT N
63Ø GOTO 59Ø
64Ø N5=N-1
65Ø FOR N=1 TO N5
66Ø IF B$="YES" THEN 68Ø
67Ø GOTO 71Ø
68Ø E1=24ØØ
69Ø B=Ø
70Ø GOTO 73Ø
71Ø E1=S(N)
72Ø B=Q(N)
73Ø M=F(N)
74Ø D=V(N)
75Ø Y=Y(N)
76Ø Y1=Y-(INT(Y/1ØØ)*1ØØ)
77Ø PRINT
78Ø IF WW$="YES" LPRINT
79Ø PRINT:CLS
80Ø IF WW$="YES" LPRINT
81Ø PRINT"POSITION OF THE MOON ON ";M;"/";D;"/";Y1;" GMT FROM"" "W$
82Ø IF WW$="YES" LPRINT"POSITION OF THE MOON ON ";M;"/";D;"/";Y1;" GMT FROM"" "W
$
83Ø PRINT
84Ø IF WW$="YES" LPRINT
85Ø PRINT"GMT"TAB(11)"GHA"TAB(21)"DEC"TAB(35)"EST"TAB(47)"AZ"TAB(57)"EL"
86Ø IF WW$="YES" LPRINT"GMT"TAB(11)"GHA"TAB(21)"DEC"TAB(35)"EST"TAB(47)"AZ"TAB(5
7)"EL"
87Ø PRINT
88Ø IF WW$="YES" LPRINT
89Ø I1=2
90Ø IF M>=3 THEN 98Ø
91Ø IF INT((Y-1853)/4)<11 THEN 94Ø
92Ø C1=-1
93Ø GOTO 95Ø
94Ø C1=Ø
95Ø J1=365*(Y-1853)+D+3Ø*(M+9)+INT((M+1Ø)/2)
96Ø J2=INT((Y-1853)/4)+1+C1
97Ø GOTO 1Ø9Ø
98Ø IF INT((Y-1852)/4)<11 THEN 1Ø1Ø
99Ø C1=-1
1ØØØ GOTO 1Ø2Ø

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1010 C1=0
1020 IF M=9 THEN 1060
1030 IF M=11 THEN 1060
1040 C2=0
1050 GOTO 1070
1060 C2=1
1070 J1=365*(Y-1852)+D+3*(M-3)+INT((M-2)/2)
1080 J2=INT((Y-1852)/4)+C1+C2
1090 J=J1+J2
1100 T1=J-17472.5
1110 D9=(B-INT(B/100)*100)+INT(B/100)*60
1120 D6=(E1-INT(E1/100)*100)+INT(E1/100)*60
1130 D7=D9-D6
1140 D8=D7-1
1150 IF D7>0 THEN 1170
1160 GOTO 1190
1170 IF D8>=0 THEN 2150
1180 B=E1
1190 T=(B-INT(B/100)*100)/144+INT(B/100)/24
1200 T5=T1+T
1210 K1=((.751213+.036601102*T5)-INT(.751213+.036601102*T5))*P5
1220 K2=((.822513+.0362916457*T5)-INT(.822513+.0362916457*T5))*P5
1230 K3=((.995766+.0273777852*T5)-INT(.995766+.0273777852*T5))*P5
1240 K4=((.974271+.0338631922*T5)-INT(.974271+.0338631922*T5))*P5
1250 K5=((.0312525+.0367481957*T5)-INT(.0312525+.0367481957*T5))*P5
1260 L8=K1+.658*R5*SIN(2*K4)+6.289*R5*SIN(K2)
1270 L8=L8-1.274*R5*SIN(K2-2*K4)-.186*R5*SIN(K3)
1280 L8=L8+.214*R5*SIN(2*K2)-.114*R5*SIN(2*K5)
1290 L8=L8-.059*R5*SIN(2*K2-2*K4)-.057*R5*SIN(K2+K3-2*K4)
1300 K6=K5+.6593*R5*SIN(2*K4)+6.2303*R5*SIN(K2)-1.272*R5*SIN(K2-2*K4)
1310 L7=5.144*R5*SIN(K6)-.146*R5*SIN(K5-2*K4)
1320 LET D1=COS(L7)*SIN(L8)*.397821+SIN(L7)*.917463
1330 LET D1=ATN(D1/(SQR(1-D1^2)))
1340 G1=50+.5+((D1)/(.792))*D5
1350 G2=80+((D1)/(.808))*D5
1360 G3=141.5-((D1)*(.738))*D5
1370 G4=170.5-((D1)*(.857))*D5
1380 A2=COS(L7)*COS(L8)/COS(D1)
1390 A1=(COS(L7)*SIN(L8)*.917463-SIN(L7)*.397821)/COS(D1)
1400 A=ATN(A1/A2)
1410 GOSUB 1670
1420 R1=A
1430 L1=.065709822*T1
1440 L=T*24*1.02738+6.646055+(L1-INT(L1/24)*24)
1450 L=(L-INT(L/24)*24)
1460 G=(L/24)*P5-R1
1470 IF G<P5 THEN 1500
1480 G=G-P5
1490 GOTO 1530
1500 IF G<0 THEN 1520

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151Ø GOTO 153Ø
152Ø G=G+P5
153Ø H=L6-G
154Ø E3=cos(L5)*cos(H)*cos(D1)+sin(D1)*sin(L5)
155Ø E2=sqr(1-(E3*E3))
156Ø E=atn((E3/E2)-(1/(61.33*E2)))
157Ø F=atn(E3/E2)
158Ø IF E<Ø THEN 21ØØ
159Ø IF E>16*Ø5 THEN 21ØØ
16ØØ A2=sin(D1)/(cos(L5)*cos(F))
161Ø A2=A2-(sin(L5)/cos(L5))*(sin(F)/cos(F))
162Ø A1=sin(L5)*sin(D1)+cos(L5)*cos(D1)*cos(H)
163Ø A1=(sin(H)*cos(D1))/sqr(1-A1*2)
164Ø A=atn(A1/A2)
165Ø GOSUB 167Ø
166Ø GOTO 182Ø
167Ø IF A=Ø THEN 169Ø
168Ø GOTO 173Ø
169Ø IF A2<Ø THEN 171Ø
17ØØ GOTO 181Ø
171Ø A=P5/2
172Ø GOTO 181Ø
173Ø IF A>Ø THEN 179Ø
174Ø IF A2<Ø THEN 177Ø
175Ø A=P5+A
176Ø GOTO 181Ø
177Ø A=P5+(A-P5/2)
178Ø GOTO 181Ø
179Ø IF A2=>Ø THEN 181Ø
18ØØ A=A+P5/2
181Ø RETURN
182Ø IF (T-I1)>(2*Ø)/144Ø THEN 184Ø
183Ø GOTO 185Ø
184Ø PRINT
185Ø BS=INT(B+.5):BS$="**##"
186Ø Z1=INT(A*Ø5*1Ø+.5)/1Ø
187Ø Z2=INT(E*Ø5*1Ø+.5)/1Ø
188Ø Z3=INT(G*Ø5*1Ø+.5)/1Ø
189Ø Z4=INT(D1*Ø5*1Ø+.5)/1Ø
19ØØ IF Z4<Ø THEN 2Ø3Ø
191Ø IF Z3<Ø1 THEN 2Ø3Ø
192Ø IF Z3>Ø2 THEN 194Ø
193Ø GOTO 197Ø
194Ø IF Z3<Ø3 THEN 199Ø
195Ø IF Z3>Ø4 THEN 2Ø3Ø
196Ø GOTO 2Ø1Ø
197Ø Y$="U"
198Ø GOTO 2Ø4Ø
199Ø Y$="W"
2ØØØ GOTO 2Ø4Ø

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2010 Y$="J"
2020 GOTO 2040
2030 Y$=" "
2040 ES=(INT(B+.5))-500
2050 IF ES<0 THEN ES=ES+2400
2060 ES$=":::###"
2070 PRINT USING BS$;BS;:PRINTTAB(10)Z3TAB(20)Z4;Y$TAB(35)USING ES$;ES;:PRINTTAB(45)
    Z1TAB(55)Z2
2080 IF WW$="YES" LPRINT USING BS$;BS;:LPRINTTAB(10)Z3TAB(20)Z4;Y$TAB(35)USING ES$;
    ES;:LPRINTTAB(45)Z1TAB(55)Z2
2090 I1=T
2100 B=B+I
2110 Z=(B-INT(B/1000))*1000-600
2120 IF Z<0 THEN 1110
2130 B=INT(B/1000)*1000+1000+Z
2140 GOTO 1110
2150 NEXT N
2160 N=0
2170 PRINT
2180 PRINT
2190 PRINT"DO YOU WANT MORE INFORMATION (YES/NO)";
2200 INPUT D$
2210 IF D$="YES" THEN 280
2220 END

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POSITION OF THE MOON ON 5 / 19 / 79 GMT FROM W2WD

GMT	GHA	DEC	EDT	AZ	EL
*615	357.4	-10	*215	106	2.2
*630	1	-9.9	*230	108.4	4.9
*645	4.6	-9.9	*245	110.8	7.5
*700	8.2	-9.8	*300	113.4	10.1
*715	11.8	-9.8	*315	115.9	12.6
*730	15.4	-9.8	*330	118.6	15.1
*745	19.1	-9.7	*345	121.3	17.5
*800	22.7	-9.7	*400	124.2	19.8
*815	26.3	-9.6	*415	127.2	22.1
*830	29.9	-9.6	*430	130.3	24.3
*845	33.5	-9.6	*445	133.5	26.4
*900	37.1	-9.5	*500	136.9	28.4
*915	40.8	-9.5	*515	140.4	30.3
*930	44.4	-9.4	*530	144.1	32
*945	48	-9.4	*545	147.9	33.6
1000	51.6	-9.4	*600	151.9	35
1015	55.2	-9.3	*615	156.1	36.2
1030	58.8	-9.3	*630	160.4	37.3
1045	62.5	-9.2	*645	164.8	38.2
1100	66.1	-9.2	*700	169.3	38.8
1115	69.7	-9.1	*715	174	39.3
1130	73.3	-9.1	*730	178.6	39.5
1145	76.9	-9.1	*745	183.3	39.5
1200	80.5	-9	*800	188	39.3
1215	84.2	-9	*815	192.6	38.8
1230	87.8	-8.9	*830	197.1	38.2
1245	91.4	-8.9	*845	201.5	37.3
1300	95	-8.9	*900	205.8	36.2
1315	98.6	-8.8	*915	210	35
1330	102.2	-8.8	*930	214	33.5
1345	105.9	-8.7	*945	217.9	31.9
1400	109.5	-8.7	1000	221.5	30.2
1415	113.1	-8.6	1015	225.1	28.3
1430	116.7	-8.6	1030	228.5	26.4
1445	120.3	-8.6	1045	231.7	24.3
1500	123.9	-8.5	1100	234.8	22.1
1515	127.6	-8.5	1115	237.8	19.8
1530	131.2	-8.4	1130	240.7	17.5
1545	134.8	-8.4	1145	243.5	15.1
1600	138.4	-8.4	1200	246.2	12.6
1615	142	-8.3	1215	248.8	10.1
1630	145.6	-8.3	1230	251.4	7.6
1645	149.3	-8.2	1245	253.9	4.9
1700	152.9	-8.2	1300	256.3	2.3





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0039      T1=FLOAT(J)-17472.5
0040      JD=FLOAT(J)+2397547.5
0041      WRITE (6,3) IDENT,LATD,LATM,LANGD,LANGM,Y,M,D,JD
0042      3  FORMAT ('1 LUNAR COORDINATES FOR 1,10A1/1 STATION LAT: 1,2I4,1
+LONG: 1,2I4/1 DATE 1,I4/1,1,I2/1,1,I2/1 JD=1,F12.1//)
0043      WRITE(6,5)
0044      5  FORMAT('          GMT          AZ          EL          GH A          DEC'//)
0045      29  D9=B - (B/100)*100 + (B/100)*60
0046      D6= E1 - (E1/100)*100 + (E1/100)*60
0047      D7=D9-D6
0048      D8=D7-I
0049      IF(D7.LE.0) GO TO 38
0050      IF(D8.GE.0) GO TO 10
0051      B=E1
C CALCULATE LUNAR LAT AND LONG
0052      38  T=FLOAT(B-(B/100)*100)/1440.+FLOAT(B/100)/24.
0053      T5=T1+T
0054      K1=FNB(0.751213+0.036601102*T5)
0055      K2=FNB(0.822513+0.0362916457*T5)
0056      K3=FNB(0.995766+0.00273777852*T5)
0057      K4=FNB(0.974271+0.0338631922*T5)
0058      K5=FNB(0.0312525+0.0367481957*T5)
0059      L8=K1+0.658*R5*SIN(2.*K4)+6.289*R5*SIN(K2)
0060      L8=L8-1.274*R5*SIN(K2-2.*K4)-0.186*R5*SIN(K3)
0061      L8=L8+0.214*R5*SIN(2.*K2)-0.114*R5*SIN(2.*K5)
0062      L8=L8-0.059*R5*SIN(2.*K2+2.*K4)-0.057*R5*SIN(K2+K3-2.*K4)
0063      K6=K5+.6593*R5*SIN(2.*K4)+6.2303*R5*SIN(K2)-1.272*R5*SIN(K2-2.*K4)
0064      L7=5.144*R5*SIN(K6)-0.146*R5*SIN(K5-2.*K4)
C CALCULATION OF RA AND DEC
0065      D1=COS(L7)*SIN(L8)*0.397821+SIN(L7)*0.917463
0066      D1=ATAN2(D1,SQRT(1.-D1**2))
0067      A2=COS(L7)*COS(L8)/COS(D1)
0068      A1=(COS(L7)*SIN(L8)*0.917463-SIN(L7)*0.397821)/COS(D1)
0069      A=ATAN2(A1,A2)
0070      R1=A
0071      L1=0.065709822*T1
0072      L=L1*24.*1.002738+6.646055+(L1-AINT(L1/24)*24.)
0073      L=(L-AINT(L/24)*24)
C CALCULATION OF GREENWICH HOUR ANGLE G FROM LOCAL SIDERIAL TIME
0074      G=(L/24)*P5-R1
0075      IF(G.LT.P5) GO TO 67
0076      G=G-P5
0077      GO TO 71
0078      67 IF(G.LT.0.) GO TO 69
0079      GO TO 71
0080      69 G=G+P5
C CALCULATION OF LOCAL HOUR ANGLE H FROM GH A
0081      71 H=L6-G
C CALCULATION OF ELEVATION E
0082      E3=COS(L5)*COS(H)*COS(D1)+SIN(D1)*SIN(L5)
0083      E2=SQRT(1-E3**2)
0084      E=ATAN2(E3,E2)
0085      IF(E.LT.0.) GO TO 117
0086      IF(E.GT.(I6*R5)) GO TO 117
C CALCULATION OF AZIMUTH A
0087      A2=SIN(D1)/(COS(L5)*COS(E))
0088      A2=A2-(SIN(L5)/COS(L5))*(SIN(E)/COS(E))
0089      A1=SIN(L5)*SIN(D1)+COS(L5)*COS(D1)*COS(H)
0090      A1=(SIN(H)*COS(D1))/SQRT(1.-A1**2)
0091      A=ATAN2(A1,A2)
0092      AZ=FNA(A)
0093      EL=FNA(E)
0094      GH=FNA(G)
0095      DEC=FNA(D1)
0096      GMT(1)=B/1000
0097      GMT(2)=B/100-(B/1000)*10
0098      GMT(3)=B/10-(B/100)*10
0099      GMT(4)=B-(B/10)*10
0100      IF((T-I1).GT.(2.*I/1440.)) WRITE (6,7)
0101      7  FORMAT(1H )
0102      104 WRITE(6,6) GMT,AZ,EL,GH A,DEC
0103      6  FORMAT(3H ,4I1,4F12.1)
0104      I1=T
0105      117 B=B+I

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0106      Z=B-(B/100)*100 - 60
0107      IF(Z.LT.0) GO TO 29
0108      B=(B/100)*100 + 100 + Z
0109      GO TO 29
0110      END

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LUNAR COORDINATES FOR G3NAQ  
 STATION LAT: 51 34 LONG: 1 18  
 DATE 1978/ 5/20 JD= 2443648.0

GMT	AZ	EL	GHA	DEC
0000	-143.7	24.3	34.2	-7.7
0010	-141.3	23.3	36.6	-7.7
0020	-138.9	22.4	39.0	-7.7
0030	-136.6	21.3	41.5	-7.8
0040	-134.4	20.3	43.8	-7.8
0050	-132.1	19.1	46.3	-7.8
0100	-129.9	18.0	48.7	-7.8
0110	-127.7	16.8	51.1	-7.9
0120	-125.6	15.6	53.4	-7.9
0130	-123.4	14.3	56.0	-7.9
0140	-121.4	13.0	58.4	-7.9
0150	-119.4	11.7	60.7	-8.0
0200	-117.4	10.4	63.1	-8.0
0210	-115.4	9.0	65.5	-8.0
0220	-113.3	7.6	68.0	-8.0
0230	-111.5	6.2	70.4	-8.1
0240	-109.6	4.8	72.8	-8.1
0250	-107.6	3.3	75.2	-8.1
0300	-105.8	1.9	77.6	-8.2
0310	-103.9	0.4	80.0	-8.2
1720	107.2	0.1	285.0	-10.5
1730	109.1	1.5	287.4	-10.5
1740	111.0	2.8	289.7	-10.5
1750	113.0	4.2	292.1	-10.6
1800	114.9	5.5	294.6	-10.6
1810	116.9	6.9	297.1	-10.6
1820	118.9	8.1	299.4	-10.6
1830	120.9	9.4	301.8	-10.7
1840	122.9	10.7	304.2	-10.7
1850	125.0	11.9	306.6	-10.7
1900	127.1	13.1	309.0	-10.7
1910	129.2	14.2	311.4	-10.8
1920	131.4	15.4	313.9	-10.8
1930	133.6	16.5	316.3	-10.8
1940	135.8	17.5	318.7	-10.8
1950	138.1	18.5	321.1	-10.9
2000	140.4	19.5	323.5	-10.9
2010	142.7	20.4	325.9	-10.9
2020	145.0	21.2	328.3	-10.9
2030	147.4	22.0	330.8	-11.0
2040	149.9	22.8	333.2	-11.0
2050	152.3	23.5	335.6	-11.0
2100	154.7	24.1	337.9	-11.1
2110	157.3	24.7	340.4	-11.1
2120	159.9	25.2	342.8	-11.1
2130	162.4	25.7	345.1	-11.1
2140	165.0	26.1	347.5	-11.1
2150	167.7	26.4	350.1	-11.1
2200	170.3	26.7	352.5	-11.2
2210	172.8	26.9	354.8	-11.2
2220	175.5	27.0	357.2	-11.2
2230	178.2	27.1	359.7	-11.2
2240	-179.1	27.0	2.0	-11.3
2250	-176.5	27.0	4.4	-11.3
2300	-173.8	26.8	6.8	-11.3
2310	-171.2	26.6	9.3	-11.4
2320	-168.6	26.3	11.7	-11.4
2330	-166.0	26.0	14.1	-11.4
2340	-163.4	25.5	16.5	-11.4
2350	-160.8	25.1	18.9	-11.5
2400	-158.3	24.5	21.3	-11.5